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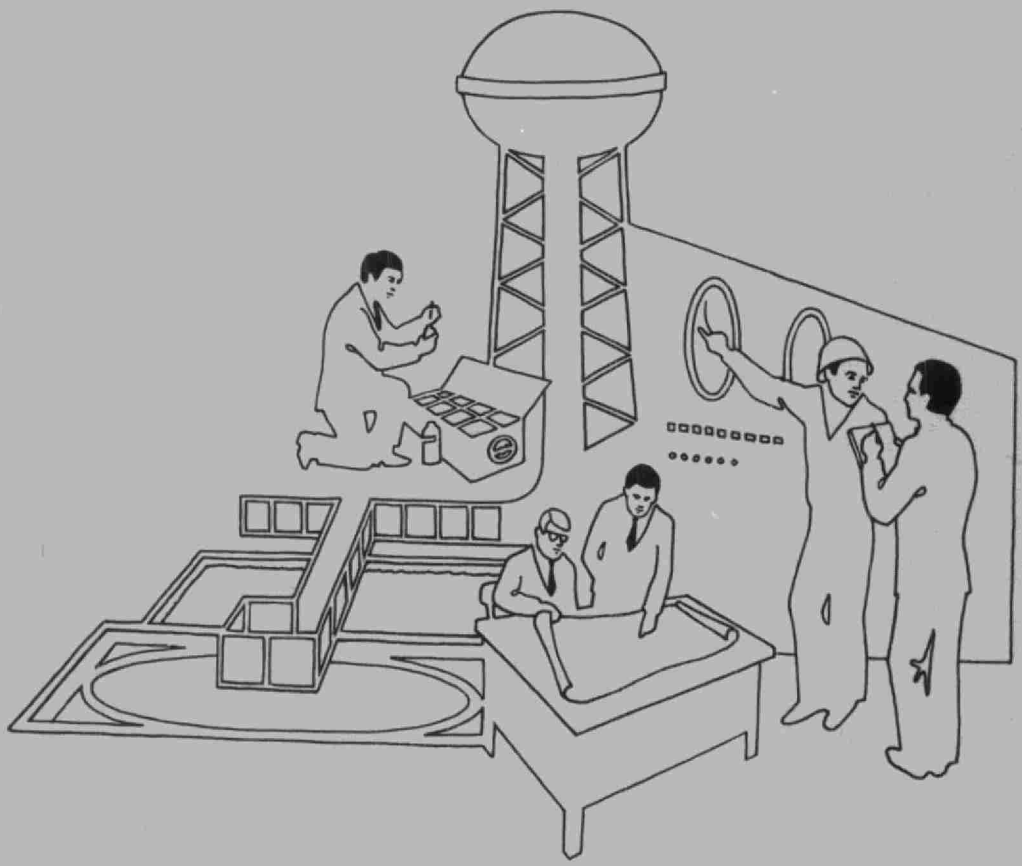

DIVISION OF SANITARY ENGINEERING

THUNDER BAY POLLUTION SURVEY - PART I

RIVERS AND STREAMS

R. T. Rinne, Student

The University of Waterloo

Waterloo, Ontario

December, 1970

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ONTARIO WATER RESOURCES COMMISSION

THUNDER BAY REGIONAL OFFICE

"THUNDER BAY POLLUTION SURVEY - PART I"

RIVERS AND STREAMS

prepared for the

Division of Sanitary Engineering

by

R. T. Rinne

The University of Waterloo

Waterloo, Ontario

December, 1970

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INTRODUCTION

OBJECTIVE

The objective of the Lakehead Pollution Survey is to determine and evaluate the extent of the pollution problem in the watercourses flowing through the City of Thunder Bay.

METHOD OF DATA EVALUATION

In the evaluation of the compiled data, impairment of the watercourse will be discussed. The parameters will be considered in relation to any significant impairment of the watercourse with regard to its assumed natural state. This control point is taken at a location far enough outside the study area so that the study area has no effect on this initial state. We also must consider if these changes in the parameters have any significant effect on the aquatic community, even though the watercourse may be impaired to some degree.

WATER QUALITY OBJECTIVES

In the parameter analysis, recommended water quality objectives are utilized as an indicator of the degree of water impairment. Wherever used, these criteria will be footnoted in reference to this page, with regard to their source.

I. GUIDELINES AND CRITERIA FOR WATER QUALITY MANAGEMENT IN ONTARIO - JUNE, 1970 - - By OWRC

(1) PWS - 1 Criteria for Public Surface Water Supplies.

(2) A. & R. - 2 Criteria for Total Body Contact Recreation

(3) F. & W. - Water Quality Criteria for the Protection of Fish, Other Aquatic Life and Wildlife.

II. (4) Objectives for Water Quality Control for the Province of Ontario, as Adopted by OWRC.

NOTE: Refer to Appendix "L"

DESCRIPTION OF STUDY AREA

GENERAL

The study area for the pollution problem objective outlined is shown in Figure I.

The shaded area on the map encompasses the urban, commercial and industrial areas of the City of Thunder Bay. The upstream monitoring points are located outside the study area. These upstream locations are basic indicators or control points with regard to the rivers in its assumed natural state. The exception to the above mentioned monitoring locations are the McKellar and Mission Rivers which are tributaries of the Kaministikwia River within the study area. All the downstream monitoring locations which are the pollution indicators are located at or near the various river mouths.

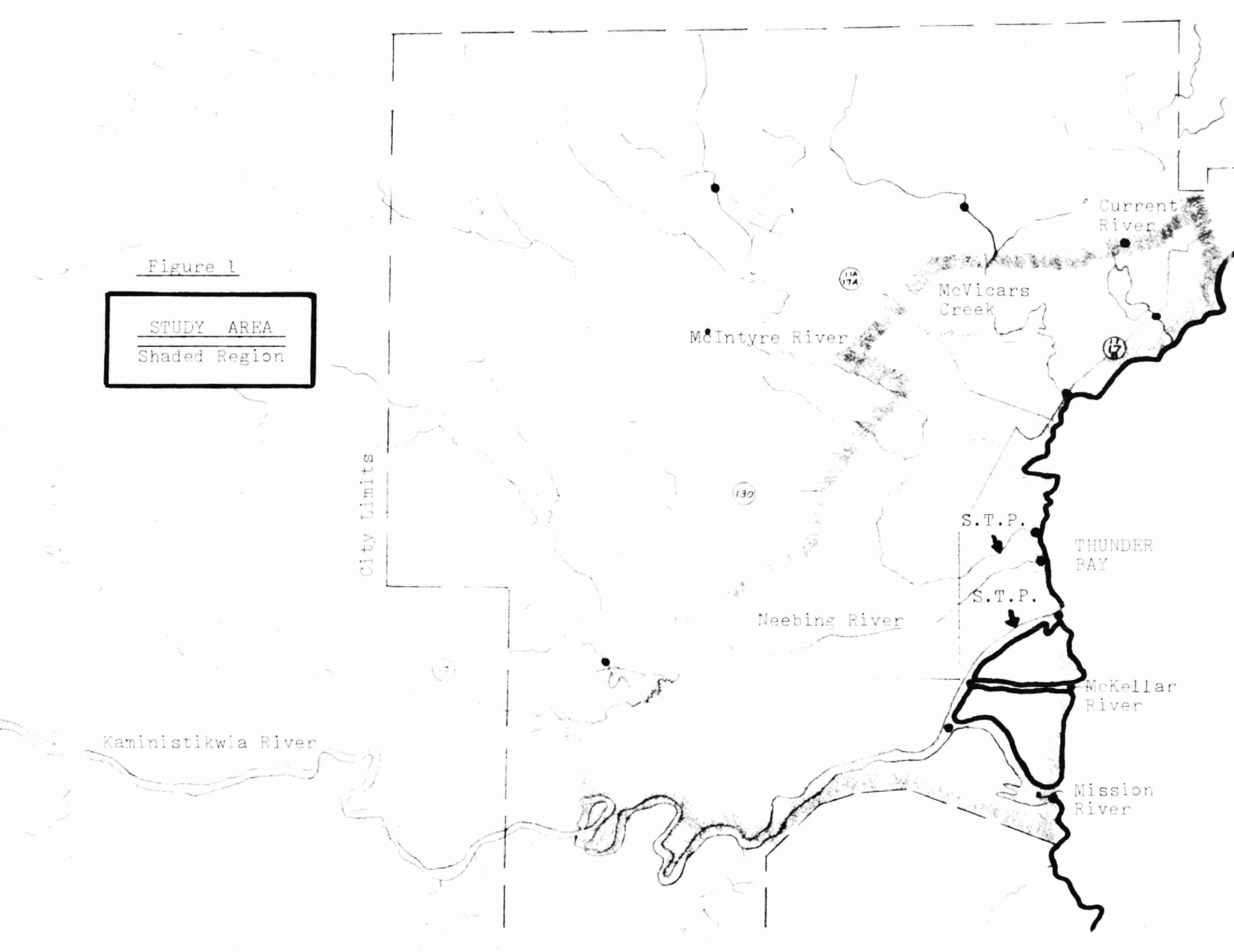
CURRENT RIVER

The Current River drains an area of approximately 265 square miles. It is a fast flowing river with many rapids along its entire course. A dam at the mouth of Onion Lake (16 miles upstream) regulates the runoff downstream. A second major control dam serving a hydro-electric power station is situated about one-half mile from the river's outlet. This downstream dam forms a recreational lake above it. Urbanization adjacent to the downstream portion of the river is minor due to the difficult topography.

KAMINISTIKWIA RIVER

The drainage of the Kaministikwia River comprises a total area of approximately 3020 square miles. The flow into the Kaministikwia River is affected somewhat by Ontario Hydro's operation on the river. Control dams are located on the Dog and Shebandowan Lake outlets flowing into the Kaministikwia River. The generating station at Silver Falls on the Kaministikwia River operates in the daytime during low and average flow periods. Its effect in the Kakabeka Falls region is considered to be minimal due to flow from intermediate reservoirs. Within

Figure 1


STUDY AREA
Shaded Region
City Limits
Current River
McVicars Creek
McIntyre River
S.T.P.
THUNDER BAY
S.T.P.
Neebing River
McKellar River
Mission River
Kaministikwia River
11A
17A
130
17
7

the study area the river is quite wide and deep compared to the other rivers under study. The gradient within the area is very gradual and next to non-existent.

Near its mouth, the river splits into three channels, the Mission, McKellar and Kaministikwia Rivers.

Within the study area we have 11 outfalls of the combined sewer type which flow directly into the Kaministikwia River. This direct untreated flow represents approximately 30 percent of the total sewage output of Thunder Bay South. Also, the Thunder Bay "F" primary sewage treatment plant has its effluent discharge into the Kaministikwia River. The industrial concentration is quite heavy along the Kaministikwia River, most of them contributing waste waters to the river.

MC INTYRE RIVER

The McIntyre River has a drainage area of approximately 64 square miles. The river above the study area is a narrow, fast flowing river which, in general, is not very deep. Its gradient tapers off and it is very nearly at the same level as Lake Superior for about two miles before emptying into Lake Superior. This level portion of the McIntyre River exhibits considerable deepening and widening of the river.

Within the study area we have two outfalls from the storm sewer system which flow into the river during periods of heavy runoff. The McIntyre Riveris also the receiver of the primary effluent from the Thunder Bay "P" primary sewage treatment plant.

MC VICAR CREEK

McVicar Creek drains a relatively small area of 20 square miles in comparison to the other surface watercourses under study. The creek meanders

through a heavily urbanized area and in general is narrow and very shallow. Steep gradients are experienced just above the study area and also for about the last mile before it enters Lake Superior.

Within the urbanized area we have 18 outfalls into the creek from the storm sewer system. During periods of above normal runoff, these outfalls discharge the storm flow from the storm sewer system. A sanitary sewer outfall from Front Street enters into the mouth of McVicar Creek as it enters Lake Superior.

NEEBING RIVER

The Neebing River has a drainage area of approximately 85 swuare miles. Outside the study area the river is comprised of three branches which meet at approximately six miles from the outlet to Lake Superior. The river level is nearly the same as that of Lake Superior for the first two miles, with little change up to as far as four miles upstream from the outlet. This river, like the McVicar, flows through a heavily urbanized area.

Outfalls from the storm sewer system flow into the Neebing River.

PARAMETER ANALYSIS

CURRENT RIVER

Biochemical Oxygen Demand (B.O.D.$_5$)

The biochemical oxygen demand means increased slightly from upstream above town to downstream at High #11-17. The upstream value of 1.0 mg/l and the downstream value of 1.2 mg/l as well as their respective maximum value are well within the criteria of 4.0 mg/l(4). (Refer to Appendix "A").

Dissolved Oxygen (D.O.)

The dissolved oxygen means are 9.6 mg/l upstream and 9.8 mg/l downstream. The upstream minimum was 4.0 mg/l whereas the downstream minimum was 7.0 mg/l. Both the mean values are above the minimum criteria for cold water biota of 5.0 mg/l (3).

Solids

A decrease from 4.1 mg/l to 3.4 mg/l was noted from the upstream to downstream monitoring locations in the suspended solids concentration.

The dissolved solids concentration is well below the desirable criteria of less than 200 mg/l (1). There was next to no increase downstream from the upstream natural state.

The turbidity experienced an increase from a mean value of 1.9 J.T.U. to 2.4 J.T.U. upstream and downstream respectively.

Chemical Oxygen Demand (C.O.D.)

The chemical oxygen demand mean value rose from 19.0 mg/l upstream to 22.0 mg/l downstream.

Nutrients

Little or no change was noticeable with regard to the nitrogen as N and phosphorus as P mean values.

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The free ammonia mean values were well below the desirable criteria of 0.5 mg/l(1) as shown in Appendix A. The mean values for nitrite increased by approximately 50% to .009 mg/l and nitrate decreased by a corresponding 50% to .044 mg/l. upstream to downstream respectively. The sum of the nitrite and nitrate values, upstream or downstream, is well below the desirable criteria.

Total phosphorus concentrations decreased considerably from an upstream mean value of 0.398 to a downstream mean value of 0.08 mg/l.

Coliform Bacteria

Coliform bacteria concentrations decreased slightly from a mean value of 78 per 100 ml upstream to 55 per 100 ml. The mean values, as well as the maximum values, are well within the criteria of 5000 per 100 ml (1) for public surface water supplies. The criteria of 1000 per 100 ml. was satisfied by the upstream and downstream mean values.

KAMINISTIKWIA RIVER

Biochemical Oxygen Demand

The biochemical oxygen demand mean for the Kaministikwia River downstream at the Empire Elevator is 4.1 mg/l which is just above the criterial value of a maximum of 4.0 mg/l(4). The downstream maximum value is 6.4 mg/l. The downstream value of 4.1 mg/l is a considerable increase from the Highway #17 mean of 1.0 mg/l with a maximum value of 1.5 mg/l. (Refer Appendix B).

Dissolved Oxygen

Upstream the dissolved oxygen content is good with a mean of 9.2 mg/l and a maximum of 7.0 mg/l. The dissolved oxygen content mean decreases to 5.4 mg/l downstream with an extreme low value of 0.1 mg/l. The downstream mean is barely above the criteria minimum of 5.0 mg/l(3) for warm water biota.

Solids

The suspended solids concentration increased from an upstream mean of 10.0 mg/l to a downstream mean of 16.4 mg/l.

The total dissolved solids concentration is below the desirable criteria of less than 200 mg/l (1). The increase from upstream to downstream is within the criteria of one-third (3) of the upstream or natural state concentration.

The turbidity increased from a mean of 9.0 J.T.U. upstream to 11.9 J.T.U. downstream. The downstream mean is above the recommended OWRC value of 10.0 J.T.U.(3).

Chemical Oxygen Demand

A slight increase from a mean of 33 mg/l upstream to a mean of 42 mg/l downstream was noted in the chemical oxygen demand.

Nutrients

Noticeable increases were noted in the free ammonia, total kjeldahl and phosphorus as P concentrations.

The free ammonia values of 0.06 mg/l upstream and 0.10 mg/l downstream represented an increase but both mean values were below the permissible criteria of 0.5 mg/l(1). The sum of the nitrite and nitrate mean values were well below the criteria (1) both downstream as well as upstream.

The total phosphorus as P concentrations increased from 0.042 mg/l upstream to 0.19 mg/l downstream.

Coliform Bacteria

The geometric mean value of 293 per 100 ml increased to 10,070 per 100 ml downstream. The downstream value is well above the criteria of 1000 per 100 ml(2) for total body contact recreation and is also well above the criteria of 5000 per 100 ml for public surface water supplies.

McKellar River

Biochemical Oxygen Demand

The upstream mean value of 25.4 mg/l decreased to 3.5 mg/l downstream. The upstream mean exceeds the recommended criteria of 4.0 mg/l(4). (Refer Appendix C).

Dissolved Oxygen

The mean values decreased from upstream to downstream with mean values of 5.8 mg/l and 5.4 mg/l respectively. These means are above the minimum recommended criteria of 5.0 mg/l(2). The minimum values of 0.0 mg/l and 2.0 mg/l upstream and downstream respectively are well below the recommended criteria.

Solids

The suspended solids mean value decreased from 32.4 mg/l upstream to 8.7 mg/l downstream.

A decrease in the dissolved solids concentrated was noted similar to that of suspended solids. The total dissolved solids values were below the maximum recommended mean value of 200 mg/l(1).

Turbidity decreased significantly with the upstream mean value being 16.2 J.T.U. to 5.3 J.T.U. downstream. The upstream mean turbidity value and the upstream maximum of 100 J.T.U. exceed the recommended maximum criteria of 10 J.T.U.(3).

Chemical Oxygen Demand

The chemical oxygen demand decreased from an upstream mean value of 91 mg/l with a maximum of 230 mg/l to 29 mg/l downstream with a maximum of 60 mg/l.

Nutrients

The nitrogen as N mean values decreased slightly.

The mean values for phosphorus as P decreased from upstream to downstream. The total phosphorus as P mean value was 0.200 mg/l upstream to 0.080 mg/l downstream.

Coliform Bacteria

A considerable drop in the coliform bacteria count mean value was noted from the upstream to downstream means. A mean value of 21,270/100 ml was noted upstream and a mean value of 7716/100 ml downstream. The maximum upstream and downstream values were 73000/100 ml and 12,600/100 ml respectively. All the values for coliform count were above the recommended criteria for total body contact recreation of 100/100 ml. The mean values upstream and downstream also were well above the criteria for surface water supplies of 5000/100 ml.

Mission River

Biochemical Oxygen Demand

The mean values decreased by 3.4 mg/l from 15.1 mg/l at the upstream monitoring location to 11.7 mg/l at the downstream location. Minimum values of 3.8 mg/l and 3.2 mg/l were recorded respectively. The means are above the recommended maximum value of 4.0 mg/l(4). (Refer to Appendix "D").

Dissolved Oxygen

The mean values of 5.9 mg/l and 5.5 mg/l upstream and downstream respectively are above the recommended minimum value of 5.0 mg/l(3). Minimum values of 1.0 mg/l and 2.0 mg/l upstream and downstream respectively are well below the recommended minimum value.

Solids

The suspended solids concentration decreased from a mean value of 12.6 mg/l to 11.6 mg/l.

The total dissolved solids concentration mean also decreased from127 mg/l to 121 mg/l. The maximum values were just above recommended maximum mean value of 200 mg/l(1).

Turbidity increased from 7.6 J.T.U. upstream to 7.7 J.T.U. downstream. The larger maximum mean value was experienced upstream at the junction of the Kaministikwia and Mission Rivers. The maximum upstream value of 13.0 J.T.U. is above the recommended maximum value of 10 J.T.U.(3).

Chemical Oxygen Demand

A decrease was noted in the means from 92.0 mg/l upstream to 77.1 mg/l downstream.

Nutrients

All nitrogen as N mean value decreased from upstream to downstream and were within the recommended values.

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Phosphorus as P encountered decreases from upstream to downstream. Total phosphorus concentration decreased from.137 mg/1 to .077 mg/1.

Coliform Bacteria

Approximately a 50 percent decrease was noted from the upstream mean to the downstream mean. The respective values were 14,100/100 ml and 5999/100 ml. Both monitoring locations exceed the surface water quality and total body contact recreation recommended maximum mean values.

McINTYRE RIVER

Biochemical Oxygen Demand

The biochemical oxygen demand varied greatly from an upstream mean of 1.0 mg/1 at highway #11A-17A. The downstream mean and the maximum values of 13.6 mg/1 and 40 mg/1 are well above the OWRC objective of a maximum biochemical oxygen demand of 4.0 mg/1(4) for surface waters. (Refer Appendix E).

Dissolved Oxygen

Upstream the mean dissolved oxygen value was 9.5 mg/1 with a minimum value of 7.0 mg/1. For cold water biota the minimum mean value is 6.0 mg/1(3) Downstream the mean value of 6.7 mg/1 was just 0.7 mg/1 above the minimum criteria whereas the minimum observed value of 1.0 mg/1 is well below the desired criteria for sustaining an aquatic community.

Solids

An increase in suspended solids occurred downstream in comparison to upstream. The upstream mean value was 4.4 mg/1 whereas the downstream value was 35 mg/1. Correspondingly, the specific conductivity was higher downstream by 122 micromhos per cm^3.

The total dissolved solids concentration increased by 89.5 mg/1 or 100 percent increase from the rivers accepted natural state. This increase is well above the desired maximum one-third increase in total dissolved solids. The mean total dissolved solids values are well below the desirable criteria of 200 mg/1(1) for public surface water supplies.

Turbidity downstream was 15.2 J.T.U. which is above the maximum of 10.0 J.T.U. desired for a cold water stream sustaining an aquatic community.

Chemical Oxygen Demand

The chemical oxygen demand increased from 29 mg/l upstream to 58 mg/l downstream.

Nutrients

Considerable increases were noticed in both the nitrogen as N and phosphorus as P values from upstream to downstream.

The free ammonia concentration mean of .024 mg/l upstream and 2.5 mg/l downstream both exceeded the desirable criteria of 0.01 mg/l(1) but the downstream value of 2.5 mg/l was well above the permissible criteria of 0.5 mg/l(1).

The nitrate concentration increased from a mean of .039 mg/l upstream to .166 mg/l downstream. The sum of nitrate and nitrite concentration means downstream was 0.205 mg/l which is well below the permissible value of 10 mg/l(1).

Noticeable increases in phosphorus were noted as illustrated in Appendix E.

Coliform Bacteria

The increase from upstream to downstream was extreme. The upstream mean was 715 per 100 ml, whereas downstream the mean was approximately 4.3×10^5 per 100 ml. The downstream mean well exceeded the OWRC objective of 5000 per 100 ml for public surface water supplies and 1000 per 100 ml for total body contact recreation.

McVICARS CREEK

Biochemical Oxygen Demand

The biochemical oxygen demand varied by only 1.3 mg/l between

Hilldale Road and Highway 11B-17B. The upstream and downstream mean values of 1.0 mg/l and 2.3 mg/l respectively along with the maximum value of 3.4 mg/l are all well within the OWRC objectives for a maximum BOD value of 4.0 mg/l(1) for surface waters. (Refer Appendix F).

Dissolved Oxygen

The upstream and downstream means are 9.0 mg/l and 9.9 mg/l with minimum values of 7.0 mg/l and 4.0 mg/l respectively. The means are well within the permissible criteria of 7 mg/l as required for public surface water supplies. The mean values are also well within the criteria for a cold water biota stream which requires a mean value of 6 mg/l(3) for dissolved oxygen.

Solids

There is a noticeable increase in the suspended solids from a mean of 3.7 mg/l upstream to 19.0 mg/l downstream. The total dissolved solids concentration means are well below the desirable criteria of 200 mg/l(1) being 123 mg/l upstream and 159 mg/l downstream. Considering the upstream mean of 123 mg/l, to be the natural condition of the receiving water, just under one-third of the natural dissolved solids have been added, where one-third is the criteria. Similarly, the specific conductance, increased by 60 micromhos per cm^3 from upstream to downstream.

Chemical Oxygen Demand

The chemical oxygen demand varied only slightly from a mean of 25 upstream to a mean of 26 downstream.

Nutrients

Significant increases were noticeable only in the free ammonia and nitrate concentrations.

The free ammonia concentration mean upstream and downstream of

0.02 mg/l and 0.04 mg/l exceeded the desirable criteria of 0.01 mg/l but are well below the permissible criteria of 0.5 mg/l(1).

An increase of 0.153 was observed from an upstream mean of 0.057 mg/l to 0.210 mg/l downstream with regard to the nitrate concentration. But the sum of nitrate and nitrite was 0.267 mg/l which is well below the permissible criteria of 10 mg/l for surface water supplies.

Coliform Bacteria

The coliform bacteria count of 626 per 100 ml (geometric mean) downstream is well below the maximum permissible values of 5000/100 ml for public surface water supplies and 1000 per 100 ml for total body contact recreation. An increase of 436 per 100 ml was experienced from the upstream value.

NEEBING RIVER

Biochemical Oxygen Demand

The biochemical oxygen demand increased slightly from a mean of 1.4 mg/l upstream above the township to 1.9 mg/l downstream at 10th Avenue. These means as well as their corresponding maximum values are well below the criteria of 4.0 mg/l(4) maximum. (Refer Appendix G).

Dissolved Oxygen

The mean dissolved oxygen values upstream and downstream are 9.9 mg/l and 8.2 mg/l respectively. Both mean values are well above the minimum criteria for a cold water biota which is 6.0 mg/l(3). The minimum values recorded were 7.0 mg/l upstream and 5.0 mg/l downstream.

Solids

The suspended solids concentrations decreased from a mean of 20 mg/l upstream to 11.8 mg/l downstream.

The total dissolved solids concentration decreased slightly from an upstream value of 163 mg/l to a downstream value of 151 mg/l, well below the maximum desirable criteria of 200 mg/l(1).

Turbidity rose from an upstream mean of 7.9 J.T.U. to 10.6 J.T.U. downstream. The downstream mean is just above the criteria maximum of 10.0 J.T.U.

Chemical Oxygen Demand

The chemical oxygen demand decreased slightly from 30 mg/l upstream to 28 mg/l downstream.

Nutrients

Increases were noted in nitrogen as N and phosphorus as P with the exception of total kjeldahl and free ammonia as N which decreased slightly.

Free ammonia decreased from a mean of 0.54 mg/l upstream to a mean of .10 mg/l downstream. The upstream mean value was not within the permissible criteria of .5 mg/l(1).

The nitrite and nitrate concentrations increased from upstream to downstream with mean values of .059 to .065 mg/l and .09 mg/l to .10 mg/l respectively. The sum of the nitrate and nitrite values are well below the permissible criteria of 10 mg/l(1).

Coliform Bacteria

The coliform bacteria count increased from a geometric mean of 615 per 100 ml upstream to 1418 per 100 ml downstream. The downstream value is permissible for public surface water supply being 5000 per 100 ml, but it exceeds the criteria of 1000 per 100 ml for total body contact recreation.

DISCUSSION AND CONCLUSIONS

From the analyses of all data, it is obvious that impairment of the watercourses occurs as they flow through the study area. The degree of impairment depends upon the overall deterioration of the water quality. The below watercourses are discussed in order of increasing impairment.

CURRENT RIVER

Relatively minor impairment with regard to the parameters was exhibited by this watercourse as summarized in Appendix "A".

Increases, even though minor, were experienced in the BOD_5, turbidity, COD, and total coliform bacteria mean values. The criteria as outlined in "Water Quality Objectives" was not exceeded. (Page 1).

From these considerations, the Current River appears to exhibit water quality attributable to a relatively unpolluted watercourse. Due to the fact that a lake is formed by the Hydro electric dam situated just above the downstream sampling locations, these downstream parameter values may not accurately represent the overall condition of the watercourse. Thus sampling on this lake, which has widespread recreational use, should be undertaken to determine if this body of water experiences greater impairment than indicated by the present downstream sampling location.

MC VICARS CREEK

As summarized in Appendix "F", the upstream and downstream mean values of the various parameters indicate a relatively minor pollution problem.

The water quality deteriorated only slightly from upstream to downstream. This impairment is noted, as all parameters except dissolved oxygen and soluable phosphorus as P showed respective increases or decreases in values corresponding to water impairment. Despite the water impairment, no downstream parameters exceeded the "Water Quality Objectives".

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At present, it seems necessary to keep this watercourse under observation with only an upstream and downstream monitoring location.

NEEBING RIVER

Similar to the two previously discussed watercourses, the Neebing River exhibits a relatively minor pollution problem.

The dissolved oxygen concentration showed a distinct decrease while the BOD_5 concentration increased indicating a slight pollution problem. (Refer Appendix G). Being a relatively slow flowing watercourse as shown by the flow data (Appendix J), the solids decreased in concentration, indicating a settling-out effect from upstream to downstream. The nitrite, nitrate and total phosphorus mean values experienced noticeable increases. Although still at relatively minor values, these nutrients encourage growth of an over abundance of plant life eventually aiding in the impairment of a watercourse. Turbidity and coliform bacteria exceeded the desirable maximum limits as required for an aquatic community and total body contact recreation respectively at the downstream location.

Considering that for nine months of the year, it exhibits a mean flow below its yearly mean of 55.3 c.f.s., this slow flowing body of water could be impaired considerably by a minor pollution contribution. Thus, continuation of the monitoring program existing of the upstream and downstream locations is suggested.

At present, eight locations on the Neebing River are being monitored, including the upstream and downstream locations. A more detailed study of this river should be conducted using available data with regard to relative water quality impairment between these adjacent monitoring locations. This study would result in conclusions with respect to the merit of the various intermediate monitoring locations.

KAMINISTIKWIA RIVER

A relatively major pollution problem is present in this watercourse with respect to the parameters considered.

To a certain degree, impairment was indicated by all parameters. The dissolved oxygen and BOD_5 mean values decreased and increased respectively to a point where the existence of an aquatic community is doubtful. The nitrate and phosphorus as P concentrations increased to an extent where growth of an over-abundance of plant life would be encouraged, contributing to the overall impairment of the watercourse. In general, the significant water impairment indicated by the parameters, indicate major discharges of wastes into the watercourse within the study area. These pollution sources must be either numerous and/or of high pollution content to effect a relatively large body of water with a mean yearly flow of 2640 c.f.s. (See Appendix "J" and "J(a)".

McKellar and Mission River channels in general exhibit water of an extremely impaired quality.

The upstream monitoring locations for these channels are intermediate locations on the Kaministikwia River within the study area. Unlike the other watercourses under study, these channels have upstream monitoring locations exhibiting extremely impaired water as shown by the data summarized in Appendix "C" and "D". The respective downstream monitoring locations indicate slight improvement in the water quality, possibly due to little or no flow in the channel which will create a settling out effect. Regardless of this slight improvement, the water is still extremely impaired and its quality is questionable with respect to the existence of an aquatic community.

A contribution to the water quality impairment of the Kaministikwia River and thus its channels is the Thunder Bay "F" primary sewage treatment plant. Other contributors are the various untreated municipal sewage outfalls and industries which discharge directly into the Kaministikwia River. Considering the degree of impairment

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noted at the junction of the Kaministikwia and Mission Rivers, a considerable portion of the waste discharges into the watercourse must occur upstream from this location. A detailed study of this river should be conducted using intermediate locations for which data is available to determine the pollution contributions and thus eliminate the sources of water impairment.

Incorporated into the Kaministikwia River study should be flow data with respect to velocity and flow directions in the two channels, the McKellar and Mission Rivers during various upstream flows on the Kaministikwia River.

McINTYRE RIVER

A major pollution problem with regard to the parameters was exhibited by this watercourse as summarized in Appendix E.

Detrimental changes with respect to water quality criteria were experienced by all the parameters. In general, all the parameters show detrimental changes of approximately 100 percent or greater from the upstream mean values. The dissolved oxygen mean value decreased to just above the minimum criteria downstream. Similarly, the BOD mean concentration increased greatly above the maximum criteria. These detrimental effects from the upstream monitoring location to the downstream monitoring location along with the approximately 100% increase in the COD concentration indicate that relatively strong wastes are being discharged to this watercourse.

The McIntyre River appears to be the most impaired watercourse of those under study. From the consideration of the data, it appears that the downstream portion of the river is unsuitable to the existence of its aquatic community and is also unfit for total body contact recreation. A contributor to this water quality impairment is the Thunder Bay "P" primary sewage treatment plant which discharges its effluent above the downstream monitoring location. Other possible contributors are the various combined

storm sewer system outfalls which empty into the river.

A detailed study of this river should be conducted using the available data (intermediate locations) to determine the various sources of pollution, their contribution and thus set out to eliminate these causes of water impairment. A flow study should be conducted on this watercourse, as no data is available at this time. This data would be very beneficial in a more detailed study of this watercourse and the interpretation of the actual pollution problem.

HARBOUR

With regard to the effect of these watercourses on the harbour inside and outside the breakwater, a separate study should be initiated with strategic monitoring locations (Refer to Appendix K). This study would provide valuable information with respect to the dilution effect of the harbour inside the breakwater, the retention effect of the breakwater, and also the eventual dilution effect of Thunder Bay outside the breakwater. In general, this study would give the overall effect of these watercourses discussed in this report on the water quality of the harbour.

RECOMMENDATIONS

(1) Flow data should be gathered with respect to the McIntyre, McKellar and Mission Rivers.

(2) A study of the intermediate monitoring locations on the Neebing River should be conducted using the data available to determine their merit.

(3) Additional monitoring locations be initiated within the breakwater and just outside the breakwater. This would be the initial step toward a study on the water quality effect of the discussed watercourses on the harbour. This study could be entitled "Thunder Bay Pollution Survey - Part III, Harbour".

(4) A study be completed to determine further the sources of pollution and their respective effects on the water quality of the McIntyre and

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Kaministikwia Rivers. Any sources of pollution or water impairment identified, should be eliminated. This study could be entitled "Thunder Bay Pollution Survey - Part II, McIntyre and Kaministikwia Rivers".

(5) Total body contact recreation should be prohibited in the downstream portions of the McIntyre River and the Kaministikwia River, as well as the McKellar and Mission Rivers.

Prepared by:

R. T. Rinne, Student
Division of Sanitary Engineering

:sn

c.c. G. H. Kay
D. A. Fast
R. T. Rinne(2)
J. R. Marsh
District Engineers Branch

APPENDIX "A"

CURRENT RIVER

Analysis / Location		B.O.D.$_5$	D.O.	SOLIDS Susp.	SOLIDS Diss.	SOLIDS Turb. Units	NITROGEN AS N NH_3	NITROGEN AS N Total Kjel.	NITROGEN AS N NO_2	NITROGEN AS N NO_3	PHOS. AS P Tot.	PHOS. AS P Sol.	Chlor. as Cl.	pH at Lab.	C.O.D.	Phenol	Cond. Umho.	Coliforms /100 ml.
pstream	Max.	2.0	[illegible]	11	104	4.2	.22	.54	.01	.39	4.0	.002	2	7.9	35.0	28	94	1800
Above	Mean	1.0	9.6	4.1	61	1.9	.05	.36	.005	.092	.398	.101	.67	7.5	19.0	6	67	78
Town	Min.	0.3	4.0	1	10	1.0	.01	.26	.003	.01	.01	.67	0	7.1	4.0	0	44	44
own-stream																		
wy.	Max.	1.7	14.0	10	94	6.0	.09	.64	.009	.41	.62	.30	2	7.9	30	12	94	320
11B-	Mean	1.2	9.8	3.4	57	2.4	.04	.42	.005	.083	.081	.044	.67	7.5	22.0	6	67.9	55
17B	Min.	0.7	7.0	1	5	0.95	.01	.31	.000	.01	.01	.004	0	6.8	10	0	43	4

Note: Data summarized in Appendices "A" to "G" are from June, 1969 to and including October, 1970.

APPENDIX "B"

KAMINISTIKWIA RIVER

Analysis / Location				SOLIDS			NITROGEN AS N				PHOS. AS P								
		B.O.D.$_5$	D.O.	Susp.	Diss.	Turb. Units	NH_3	Total Kjel.	NO_2	NO_3	Tot.	Sol.	Chlor. as Cl.	pH at Lab.	C.O.D.	Phenol	Cond. Umho.	Coliforms /100 ml.
stream	Max.	1.5	12.0	38	132	56	.21	1.2	.02	.20	.098	.04	2	7.8	50	9	91	132,000
hwy.	Mean	1.0	9.2	10	76	9.0	.06	.50	.007	.06	.042	.014	0.9	7.2	33	4.4	77	293
#17	Min.	0.3	7.0	1	22	2.0	.01	.09	.004	.002	.01	.00	0	6.7	20	0	62	4
down- stream	Max.	6.4	11.0	60	181	50	.19	1.1	.019	.16	.80	.78	9	7.5	80	25	155	121,000
Empire	Mean	4.1	5.4	16.4	101	11.9	.10	.74	.008	.066	.19	.094	4	7.1	42	12	120	10,070
Elev.	Min.	2.5	0.1	5	26	4.4	.00	.23	.004	.007	.03	.007	0	6.3	10	3	89	820

APPENDIX "C"

McKELLAR RIVER

Location / Analysis		B.O.D.$_5$	D.O.	SOLIDS Susp.	SOLIDS Diss.	SOLIDS Turb. Units	NITROGEN AS N NH_3	NITROGEN AS N Total Kjel.	NITROGEN AS N NO_2	NITROGEN AS N NO_3	PHOS. AS P Tot.	PHOS. AS P Sol.	Chlor. as Cl.	pH at Lab.	C.O.D.	Phenol	Cond. Umho.	Coliforms /100 ml.
›stream ım R.	Max.	52	15.0	223	296	100	.29	1.3	.029	.18	.60	.21	19	7.3	230	40	240	120,000
: Ind. r. Prod.	Mean	25.3	5.8	32.4	135	16.2	.07	.86	.009	.041	.200	.058	6.8	6.9	91	17	129	21,270
;arch Lant	Min.	3.0	0	4	70	2	.01	.45	.003	.00	.02	.004	0	6.3	20	6	83	1,740
›wn- stream ›uth of :Kellar :iver	Max.	5.5	9.0	20	115	10	1.3	1.1	.010	.09	1.9	.54	6	7.3	60	15	130	12,600
	Mean	3.5	5.4	8.7	83.4	5.3	.04	.54	.006	.046	.080	.065	4.0	7.0	29	10	113	7,716
	Min.	1.8	2.0	1	56	2.5	.00	.09	.000	.00	.03	.00	0	6.5	20	4	84	650

APPENDIX "D"

MISSION RIVER

Analysis / Location				SOLIDS			NITROGEN AS N				PHOS. AS P							
		B.O.D.$_5$	D.O.	Susp.	Diss.	Turb. Units	NH_3	Total Kjel.	NO_2	NO_3	Tot.	Sol.	Chlor. as Cl.	pH at Lab.	C.O.D.	Phenol	Cond. Umho.	Coliforms /100 ml.
stream	Max.	33	10.0	21	230	13	.10	.90	.011	.01	.80	.07	18	7.3	190	35	179	71,000
t. of m and ission Rivers	Mean	15.1	5.9	12.6	127	7.6	.03	.65	.007	.004	.137	.020	7.9	6.9	92	15.8	137	14,100
	Min.	3.8	1.0	7	63	4	.00	.24	.00	.00	.03	.007	0	6.5	10	0	80	5,400
own-stream outh of ission River	Max.	34	10.0	20	219	10	.07	.80	.009	.01	**.14**	.05	14	7.3	170	40	167	2,400
	Mean	11.7	5.5	11.6	121	7.7	.02	.52	.006	.004	.077	.014	7.3	6.9	77	14.5	131	5,999
	Min.	3.2	2.0	5	54	5.5	.00	.09	.00	.00	.040	.004	0	6.5	31	0	79	1,200

APPENDIX "E"

McINTYRE RIVER

Analysis / Location		B.O.D.$_5$	D.O.	SOLIDS Susp.	SOLIDS Diss.	SOLIDS Turb. Units	NITROGEN AS N NH_3	NITROGEN AS N Total Kjel.	NITROGEN AS N NO_2	NITROGEN AS N NO_3	PHOS. AS P Tot.	PHOS. AS P Sol.	Chlor. as Cl.	pH at Lab.	C.O.D.	Phenol	Cond. Umho.	Coliforms /100 ml.
pstream	Max.	1.9	13.0	6	121	10	.05	.70	.008	.210	.18	.086	6	7.9	50	7	186	4,000
hwy.	Mean	1.0	9.5	4.4	89.5	3.9	.024	.48	.006	.039	.058	.026	1.8	7.4	29	2.1	127	715
11-17	Min.	0.4	7.0	1	53	1.3	.01	.10	.003	.003	.01	.003	0	6.5	8	0	75	96
)own-	Max.	40.0	12.0	107	275	50.0	10.0	17.0	.08	.59	4.7	2.4	32	7.6	90	20	425	$4.9X10^7$
stream	Mean	13.6	6.7	35	179	15.2	2.5	4.62	.013	.166	1.29	.612	13.7	7.3	58	7.5	251	425,500
Hamilton	Min.	1.5	1.0	2	117	3.7	.12	.80	0.0	.001	.07	.023	6	7.0	30	0	148	256
Ave.																		

APPENDIX "F"

McVICARS CREEK

Location / Analysis		B.O.D.$_5$	D.O.	SOLIDS Susp.	SOLIDS Diss.	SOLIDS Turb. Units	NITROGEN AS N NH_3	NITROGEN AS N Total Kjel.	NITROGEN AS N NO_2	NITROGEN AS N NO_3	PHOS. AS P Tot.	PHOS. AS P Sol.	Chlor. as Cl.	pH at Lab.	C.O.D.	Phenol	Cond. Umho.	Coliforms /100 ml.
stream illdale Rd.	Max.	1.7	13.0	8	189	48	.05	.75	.008	.19	.48	.12	4	8.0	40	9	244	2,700
	Mean	1.0	9.0	3.7	123	5.2	.02	.39	.004	.057	.006	.024	.91	7.4	25	3.6	153	190
	Min.	.03	7.0	1	51	1.0	.00	.09	.001	.01	.009	.004	0	6.8	10	0	72	20
wn- Stream ghway 1B-17B	Max.	3.4	15.0	84	222	9.5	.07	.77	.010	.54	.092	.080	8	8.0	35	35	338	9,400
	Mean	2.3	9.9	19	159	6.0	.04	.43	.006	.21	.028	.017	4.5	7.7	26	11	213	626
	Min.	0.6	4.0	2	99	1.7	.01	.24	.003	.05	.01	.005	1	7.0	20	0	132	44

APPENDIX "G"

NEEBING RIVER

Location / Analysis		B.O.D.$_5$	D.O.	SOLIDS Susp.	SOLIDS Diss.	SOLIDS Turb. Units	NITROGEN AS N NH_3	NITROGEN AS N Total Kjel.	NITROGEN AS N NO_2	NITROGEN AS N NO_3	PHOS. AS P Tot.	PHOS. AS P Sol.	Chlor. as Cl.	pH at Lab.	C.O.D.	Phenol	Cond. Umho.	Coliforms /100 ml.
pstream	Max.	3.5	14.0	73	280	30.0	.24	4.5	.020	.41	.34	.046	20	8.0	40	15	319	3,800
Above	Mean	1.4	9.9	20	163	7.9	.54	1.09	.059	.09	.079	.012	5.5	7.4	30	6.0	212	615
ownship)	Min.	.06	7.0	1	87	2.5	.01	.32	.002	.01	.02	.00	2	6.8	20	0	140	24
own- stream	Max.	3.8	11.0	29	204	20.0	.33	1.6	.011	.41	2.6	.15	15	7.8	40	10	293	$1X10^5$
10th	Mean	1.9	8.2	11.8	151	10.6	.10	.80	.065	.10	.315	.038	7.5	7.5	28	4.5	225	1418
Ave.)	Min.	0.5	5.0	4	110	5.2	.01	.34	.003	.01	.02	.006	4	7.3	20	0	158	104

APPENDIX "H"

TOTAL PRECIPATION - STUDY AREA

1969

	January	February	March	April	May	June	July	August	September	October	November	December
nches	3.41	.50	.32	1.36	2.54	2.26	1.55	2.12	2.25	1.60	1.14	1.79

Mean: 1.74

1970

1.73	0.70	1.47	4.15	5.66	1.89	3.68	1.64	3.40	6.56	

Mean: 3.09

Data Source: Dept. of Transport - Thunder Bay Airport Weather Office

APPENDIX "I"

FLOW DATA

NEEBING RIVER NEAR THUNDER BAY (1969)

Month Data	January	February	March	April	May	June	July	August	September	October	November	December
Mean Discharge (cfs)	19.5	10.8	2.2	425	83.0	63.6	11.4	12.1	5.5	14.7	12.8	7.3
Maximum Discharge (cfs)	27.0	22.3	3.2	1180	207	202	29.7	48.0	14.8	49.0	20.7	13.2
Minimum Discharge (cfs)	13.6	3.5	1.3	1.1	27.9	21.6	4.2	3.4	3.8	8.0	7.5	6.0

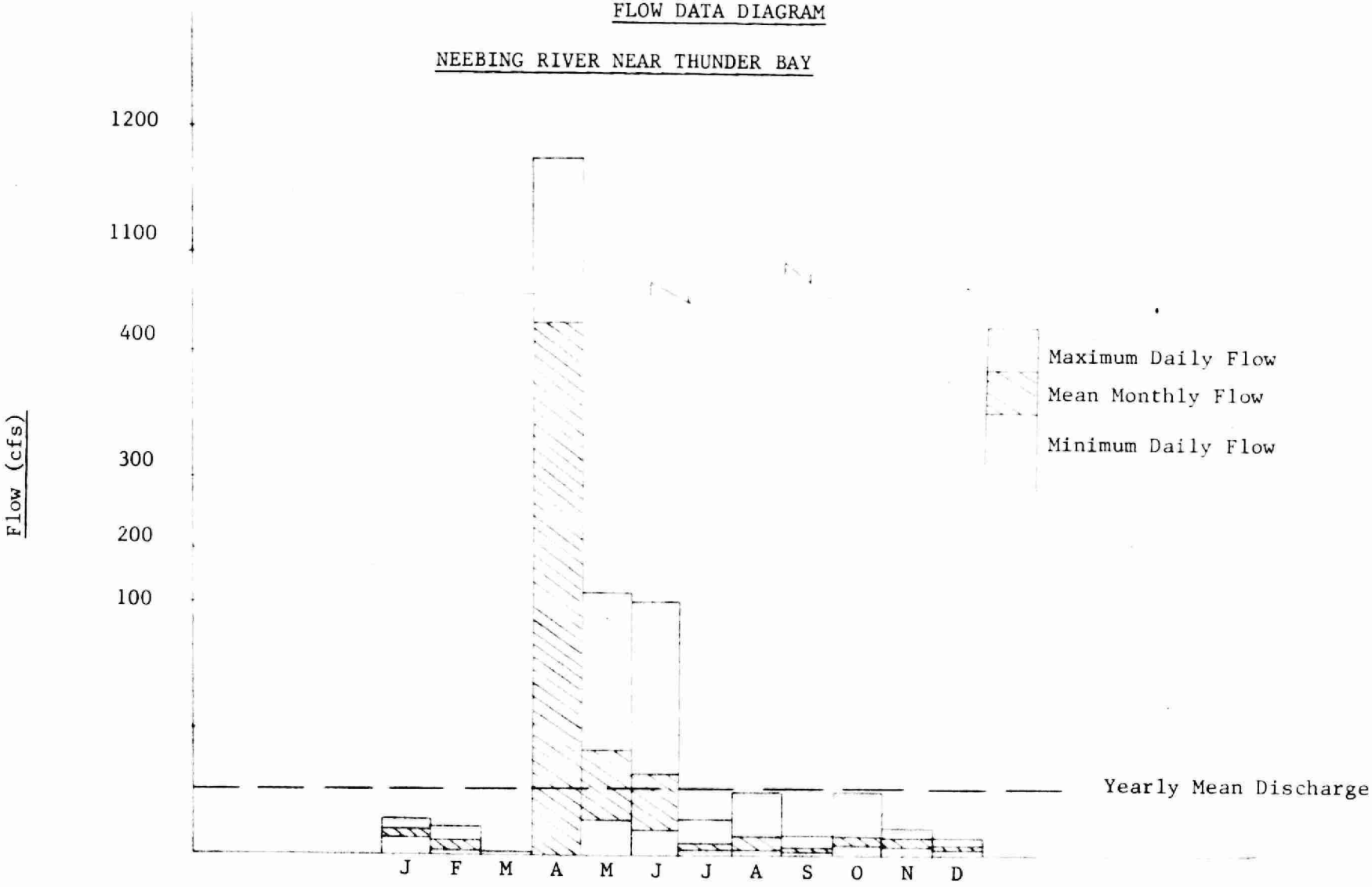
Mean Discharge of 55.3 cfs

* Provisional Data - Dept. of Energy, Mines and Resources - Water Survey of Canada

APPENDIX I(a)

FLOW DATA DIAGRAM

NEEBING RIVER NEAR THUNDER BAY



APPENDIX J

FLOW DATA

KAMINISTIKWIA RIVER AT KAMINISTIKWIA (1969)

Month Data	January	February	March	April	May	June	July	August	September	October	November	December
Mean Discharge (cfs)	2720	2470	2680	5520	4150	2930	2500	2180	1460	1700	1670	1700
Maximum Discharge (cfs)	3930	2710	2810	9540	5930	4070	3230	3200	1830	2490	1910	2690
Minimum Discharge (cfs)	1390	2140	2510	2640	2290	1990	1610	724	717	914	1430	1430

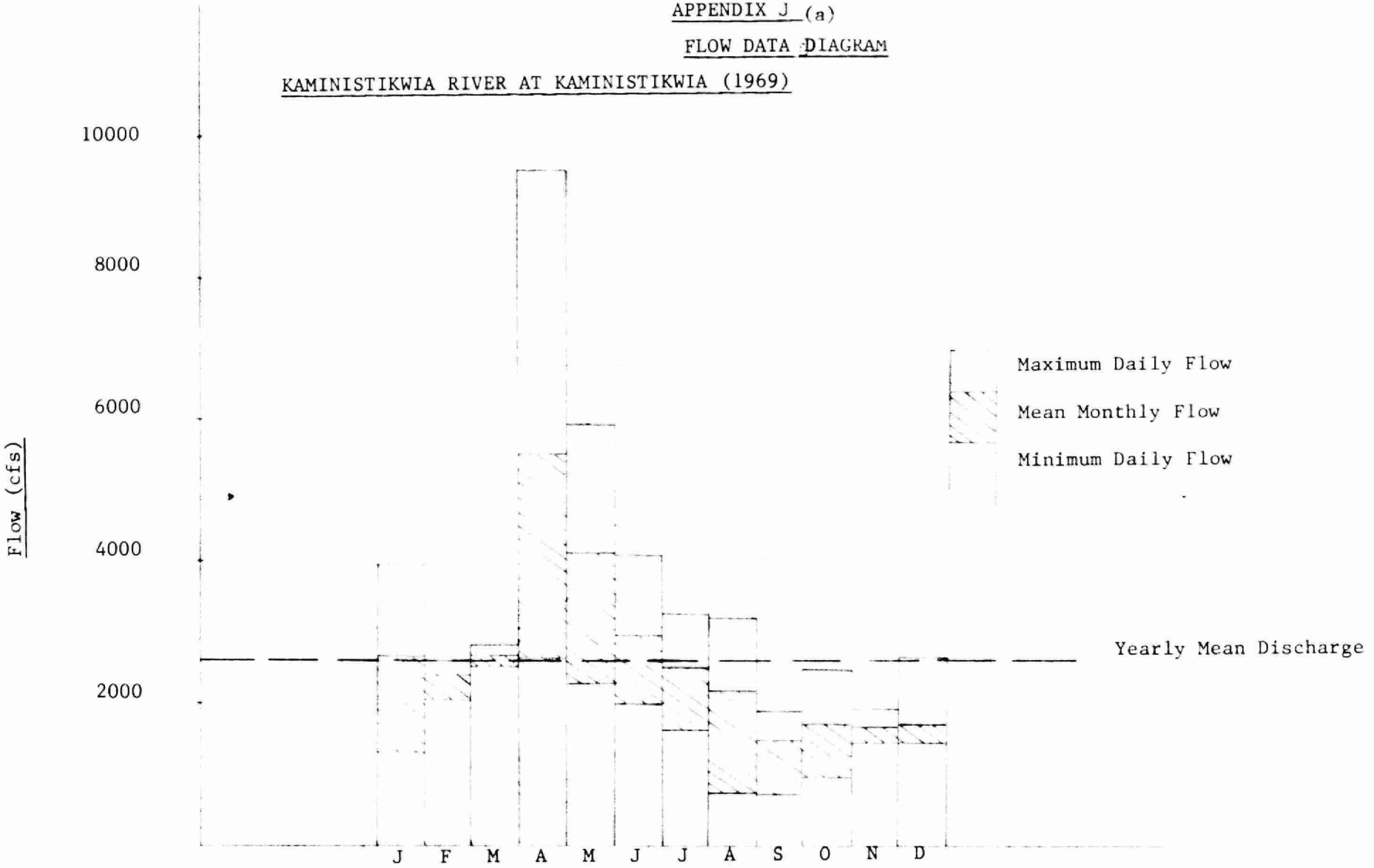
Mean Discharge of 2640 cfs

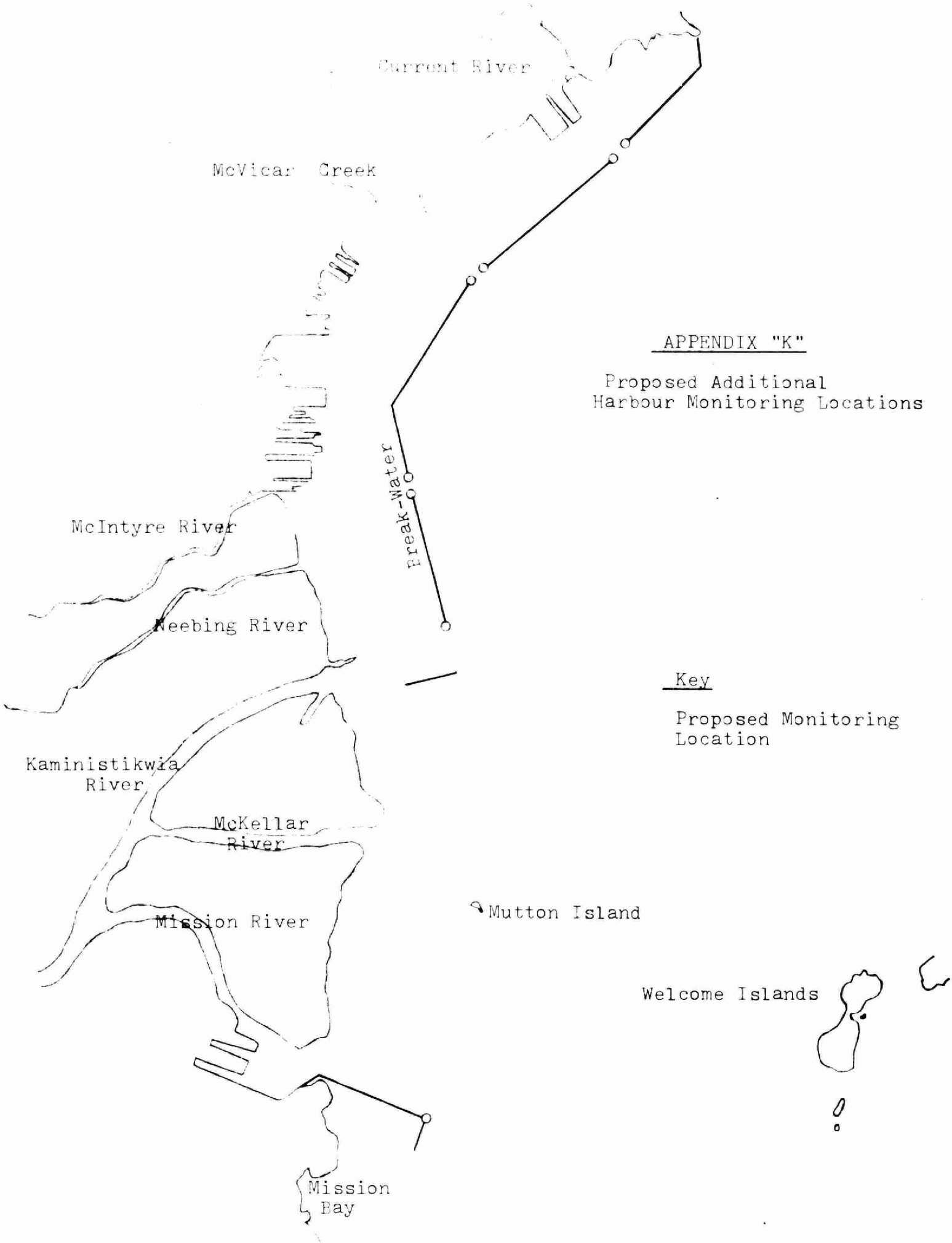
Provisional Data - Dept. of Energy, Mines and Resources - Water Survey of Canada

APPENDIX J (a)

FLOW DATA DIAGRAM

KAMINISTIKWIA RIVER AT KAMINISTIKWIA (1969)





APPENDIX "K"

Proposed Additional
Harbour Monitoring Locations

Key

Proposed Monitoring
Location

APPENDIX "L"

	Criteria for Public Surface Water Supplies (1)		Criteria for Total Body Contact Recreation(2)	Water Quality Criteria for Protection of Fish, Other Aquatic Life & Wildlife(3)	Objective for Water Quality Control (4)
	Permissable	Desirable			
B.O.D.5					< 4 mg/l
D.O.				> 5 mg/l* > 6 mg/l**	
S.S.					
D.S.	500 mg/l	< 200 mg/l		Addition less than 1/3natural condition	
Turbidity				< 25 J.T.U.* < 10 J.T.U.**	
C.O.D.					
NH_3 as N	0.5 mg/l	< 0.01 mg/l			
$NO_2 + NO_3$	10 (ASN)	Absent			
Coliform Bacteria	5000/100ml		1000/100 ml		

* For warm water biota - Kaministikwia River

** For cold water biota - McVicar Creek, McIntyre, Current and Neebing Rivers

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Date Due

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